Hunger and Perception

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During the past several years the reader of psychological journals has been bombarded by a series of experiments and discussions on the relationship between hypothetical need states and various measures of perceptual behavior The evidence is quite impressive that such relationships do exist under a variety of conditions However, little systematic attention has been given to a critical analysis of the criteria of perception which have been employed in these experiments, and to the conditions under which these relationships are found To understand the mechanism of this phenomenon (or perhaps these phenomena), a careful analysis of the circumstances under which positive and negative findings occur, as well as a study of the kinds of perception which are capable of being molded by personality and need variables, is required

Particularly prominent among the studies persistently cited as providing evidence of the motivated nature of perception is a series of experiments using hunger as the independent variable (**1, 2, 5, 6, 9, 10**)

In this article these half-dozen studies on hunger and perception will be discussed briefly In addition, two experiments will be described which may throw some light on the question of the criterion of perception and the mechanism of need and perception relationships

Some years ago Sanford (**9, 10**) performed two experiments in which he systematically varied hours after eating and studied the effects upon such imaginal and associational variables as the content of word associations, the interpretation of ambiguous pictures, and

[1] A very large portion of the data for the two experiments which are reported here was collected by three students, Herbert Yousem (now studying at The University of Maryland Medical School), David Arenberg, and Robert Hamilton (now a psychology graduate student at The Johns Hopkins University). All three of these students must be congratulated on their diligence in the performance of these studies The senior author takes the responsibility for some data collection, the organization of the project, and the preparation of the article.

the completion of words and drawings In general, Sanford found a positive relationship between food deprivation on the frequency of food responses, although this increase was not in direct ratio to the increase in time

A later experiment related to hunger and perceptual behavior was performed by Levine, Chein, and Murphy (5) These authors tested a small group of experimental and control subjects on the interpretation of simple drawings which were presented behind a ground glass screen to make them completely ambiguous The experimental subjects were instructed to fast for various periods of time prior to the experimental sessions The authors found that the number of food responses given for achromatic drawings increased at three and six hours of deprivation, decreasing at nine hours For chromatic drawings, food responses increased at three hours' deprivation, but then decreased at six and nine hours from the last meal These curves were questionably interpreted to mean that greater ambiguity of stimuli (the use of chromatic drawings suggested greater ambiguity to the authors) favors some kind of reality process that operates in contrast to autism (perceiving in accordance with the hunger need)

More recently, two experiments were performed with adult Navy personnel by McClelland and Atkinson (6) and Atkinson and McClelland (1) In the first experiment (6), the authors projected blank images and smudges on a screen with varying amounts of hints to the subject concerning what they might be They measured the effects of varying degrees of food deprivation on the frequency of food-related responses The main finding was that as hunger increased from 1 to 4 to 16 hours of deprivation, the average frequency of food responses increased in a negatively accelerated way Moreover, the introduction of smudges decreased the number of food responses compared with the blank screen condition Instrumental responses (knives, plates, etc) showed the greatest increase in frequency. In the second experiment (1), this work was extended to the Thematic Apperception Test in an effort to study the clinical procedure of inferring needs from projective behavior The essential results were that as hunger increased, there was an increase in the percentage of subjects showing food deprivation themas, story characters expressing a need for food, and activity which was successful in overcoming the deprivation, as well as a decrease in the amount of goal activity and friendly press (involving help in getting food).

The final experiment which is directly relevant to the present issues was performed during the last war and reported by Brozek *et al.* (2). Thirty-six conscientious objectors who had volunteered as subjects were exposed to a study of prolonged semistarvation During the semistarvation period, observations of the men indicated severe personality changes and a marked increase in the food drive However, in spite of the extreme interest in food and the obvious signs of such preoccupation, only limited aspects of the free association test (starved subjects gave significantly more unusual responses to the food stimulus words than controls) showed any systematic effects of the starvation. Measures of restricted association, dream content, Rorschach projections, and the results of the Rosenzweig Picture-Frustration Test provided essentially negative results.

BASIC ISSUES RAISED BY THE HUNGER AND PERCEPTION EXPERIMENTS

For the purposes of this article, there is little to be gained by an intensive critique of each of the experiments cited here Some of the findings among the experiments are not consistent. While Sanford, McClelland and Atkinson, and Levine, *et al.*, found food associations are a function of hunger, Brozek, *et al.* obtained no such relationship in most of the functions they measured. While McClelland and Atkinson avoided giving their subjects a "food set," Levine, Chein, and Murphy made a special effort to introduce such a set Levine, *et al.* found food interpretations decreasing at six and nine hours' deprivation, depending on the type of stimuli. Sanford found at least no increase above four hours, and McClelland and Atkinson's data showed a negatively accelerated function. Except for Brozek, *et al.*, there is some rough agreement that the relationship is either not monotonic, or at least is negatively accelerated.

It is also true that these experiments, taken individually and as a group, have been the subject of much just criticism. Indirectly, Pastore (8) has seriously questioned the propositions upon which they were based He offers a critique of the need in perception experiments in general, and a separate criticism of the experiment by Levine, *et al.* It seems more relevant at the present time to raise two basic issues (focusing upon those studies using hunger as the independent variable), and to develop them with respect to the experiments to be reported here.

The first issue concerns the way one should define perception and the second has to do with the nature of the process in the need in perception relationships Both questions are intimately related The answer to both must have to do with the kind of stimulus and response situations that enter into the perceptual behavior studied Therefore, in considering the experiments that have been cited and the studies to be reported here, we may focus upon such experimental variables as the type of stimulus, the means by which the stimulus is made ambiguous or is presented at below and above the threshold of recognition, and the nature and conditions of the responses that the subject gives to the perceptual situation.

The experiments cited above all appear to be dealing with a special kind of perceptual behavior which ought to be differentiated from other kinds of perception. While Sanford made no claim to be dealing with perception, the above experiments have been repeatedly cited as demonstrating the interdependence of need states and perception. There is a growing tendency to define perception practically without reference to a stimulus of any kind. While Sanford spoke of the "imaginal processes," Levine, *et al.* used the expression "perceptual distortion," McClelland and Atkinson used the term "perception," and Brozek, *et al* spoke of "perception and association." And yet, ***the closest any of the experiments came to considering perception even partly in terms of a stimulus variable was that of Levine, Chein, and Murphy, who projected chromatic and achromatic drawings distorted behind a ground glass screen.*** Most of the time McClelland and Atkinson projected nothing on the screen, and, at times, nothing but vague smudges. What we are dealing with, then, in all these experiments, is something more like projection, association, interpretation of formless objects, imagery, phantasy, or some such psychological behavior, rather than, strictly speaking, perception in terms of the identification of objective stimuli There are probably important differences between these intimately related forms of perceptual behavior which determine the kinds of conclusions one may draw about the principles in the area of needs and perceptual selectivity.

Now it is clear that attempting to make the kind of distinction that is sought here is no simple matter, and is likely to get the person who makes it into all kinds of epistemological confusions However, it does seem that the interpretation of ambiguous blots or of blank images on a screen does involve some differentiation from the identification of objective stimuli which have a common label and about which we can get almost universal agreement We must ask if it makes any difference whether we show the hungry subject nothing, ambiguous blobs, real objects, pictures of objects, or words which stand for the objects This is the case whether we are dealing with needs like hunger or hypothetical ego-defense processes as in some very recent experiments

At this point a few comments would be in order concerning the much-used but little-discussed notion of ambiguity in perceptual experiments It seems to the writer that ambiguity, which is thought to be a necessary requisite of need and perceptual relationships, must be thought of in terms of the number of reasonable alternatives that any given population may offer in response to the request to identify or interpret a stimulus This point has been made in a previous article dealing with perceptual defense (3) If everyone agrees that the stimulus is a typewriter, then it is hardly ambiguous However, as the number of interpretations that are possible increase, say to include a roast ham, an office desk, a cigarette lighter, etc , the stimulus may be said to be more ambiguous Even a blob or smudge on a screen may have some structure, however slight, because most viewers would agree that it could not be certain things while it could be others The concept of the popular response and the good form response on the Rorschach Test takes recognition of the incomplete ambiguity of the ink blots While it may be dangerous to argue that if most people perceive a fountain pen as a fountain pen the stimulus really is a fountain pen, it is eminently practical, and there could be no society if we did not

The distinction that the present author is proposing, therefore, between the two kinds of interrelated perceptions, that which seems to be more oriented toward imagination, association, or projection, and that which is more stimulus-oriented, depends upon the criterion that the experimenter uses to score the response If the correctness of the response depends largely upon the characteristics of the stimulus, rather than some hypothetical state in the organism, then this might be called perceptual behavior in the strictest sense The criterion depends upon using stimuli about whose identification nearly everyone will finally agree In the case of words, the subjects will all finally arrive at the correct recognition, at least given an unlimited exposure The technique for introducing temporary ambiguity may be the rapid exposure of the words or letters on a screen, or the use of subliminal illumination which is progressively increased to what is called "above threshold levels" At early stages in this progression the perceptual process may indeed be closely analogous to the interpretation of completely ambiguous blobs In the case of pictures, all subjects should eventually arrive at the agreed upon designation of the stimulus If this is not so, then the stimulus is truly ambiguous, and cannot be used in an experiment on perception in the strictest sense In the experiments by Levine, *et al* and by McClelland and Atkinson, stimulus ambiguity was half-heartedly varied in terms of chromatic *vs* achromatic drawings, and smudges *vs* no image at all, respectively

In dealing with the question of the mechanism of the need and perception relationships, it is also appropriate to point out that explanations have been offered in terms of the concept of response frequency Some writers have argued that needs affect perceptual recognition by virtue of the recency and frequency of certain words, and that greater frequency of experience with a word results in lower recognition thresholds (11) This argument has been most extensively used in connection with experiments on needs and the visual recognition thresholds of words While the interpretations of the relevant data are controversial at the present time, this is one of the hypotheses about the need in perception relationships that bears investigation, and on which the experiments to be cited here have a bearing

Two experiments will be reported Both were designed to be comparable with some of the earlier experiments on hunger and perceptual recognition However, they employed pictures of food and nonfood objects which, when exposed fully to subjects, would be unequivocally identified by all The two experiments are nearly identical, except for the fact that in one the subject was free to make his own guesses with no restrictions imposed upon his responses, and in the second experiment the subject was forced to choose from among a limited group of alternatives which were always before him, and which represented the range of stimuli which were being used in experiment.

Present Procedures

The subjects in these experiments were 110 and 51 volunteer male college students, respectively, who were individually tested at a time when they indicated they were free to participate. They were told that this was an experiment in the perceptual recognition of familiar objects, presented in the form of photographs by means of a tachistoscope and variac, which were described to them. They were told that we were interested in the effects on recognition of such variables as illumination, time of day, fatigue, etc. The ascending method of limits was explained to them with the caution that we would finish with each picture before going on to the next, and that, since the number of exposures was fixed in advance, the presentations would continue, sometimes even long after the subject had correctly identified the object. Presentations were all made at one-fifth of a second, on a ground glass screen, using a small lantern slide projector with a camera shutter attached. By means of the variac, the first exposure began at 22 volts and proceeded upward in one-volt steps, always going past the point of recognition by the subject. For example, if the subject identified the stimulus correctly five times in a row (which was the criterion of success), exposures continued for a variable period of about 10 to 15 times thereafter. If a subject failed to recognize the object after 59 exposures, he was allowed to view it for longer periods until it was established that he could, indeed, identify the object. But in that case, he was given no score for that slide since carrying the item to a slower speed would have resulted in a fairly meaningless score to represent his perceptual threshold. Any subject who did not recognize at least 60 per cent of the slides within the 59 exposures was discarded. There were nine such cases. After each exposure, the subject always made a guess, even if he claimed to have no idea whatever concerning the nature of the stimulus.

The stimulus materials consisted of 10 slides which were made from photographs of a series of food and nonfood objects. Food pictures consisted of a bunch of grapes, a dish of pancakes, a two-thirds-full bottle of milk, an ear of corn, and a double-decker toasted sandwich. The nonfood objects were a pocket cigarette lighter, an open portable typewriter, a mountable pencil sharpener, a bellows-type camera, and a household hand iron The presentation of these slides was always the same for all subjects, and randomized in an ABBA order The first trial always consisted of a practice slide in which a photograph of an electric clock was used

When each subject had completed the series, he was interviewed concerning his eating habits, given the word-association test used by Sanford in his second experiment, and asked to rate his degree of subjective hunger on a five-point scale None of the subjects appeared to have guessed the purpose of the experiment, or realizd that half of the pictures were food objects From the interview data, it was possible to place the subject accurately in terms of time since his last meal, using the beginning of that meal and the start of the experiment as points of reference

The only deviation from the random testing of subjects occurred with some of the students falling in the five- and six-hour deprivation period After the collection of considerable data it became apparent that there was a shortage of subjects who had not eaten in five or six hours This group was supplemented by collecting some subjects just before lunch would normally occur, and, with their consent as well as under the pretext of having them wait under carefully controlled visual conditions, managing to delay testing of these subjects until the proper hunger interval had been reached

There were some subjects who, for some reason or another, had been without food for longer periods, from 7 to 23 hours Because these subjects were so scattered in terms of hours of deprivation and represented a small group, they were not included in the sample of data reported It might be noted, in passing, that these subjects were exceedingly variable among themselves in their performance and present no analyzable trends

The second experiment was performed in exactly the same way as the first, but with the exception that in front of the subject at all times was a verbal list of the 10 pictures, plus an additional six dummy items, half of which were food and half of which were nonfood items. Moreover, the word-association procedure was abandoned The subject was told to select his guess from this list of 16 items, which was always before him, and the order of which was constantly changed to prevent list-order preferences

RESULTS

The findings of the present experiment may be separated into the basic perceptual data including the relationships between recognition thresholds and hours of deprivation and subjective hunger, data dealing with prerecognition guesses and word-association, and qualitative observations. The perceptual recognition thresholds were scored in terms of a formula used by McClelland and Liberman (7) in an experiment on the need for achievement For each subject, the mean number of exposures (before the criterion) of the food pictures was subtracted from the mean number of exposures of the nonfood pictures This difference score was divided by the sigma of the nonfood pictures to take account of the effects of differences in the variability of perceptual recognition among the subjects

One final fact must be pointed out before the data are presented Experiment 1 was repeated twice, once with an N of 41, the second time with an N of 69, to make a total of 110 cases for the combined experiments Each experiment was performed by a different experimenter and upon different subjects. The purpose of this repetition was to check on one special aspect of the results Since, in the first study, the relationship between hunger and perceptual recognition was not monotonic (viz , Levine, *et al.*), it was felt that a kind of cross validation was necessary before any confidence could be placed in the observations Although the data have been analyzed mainly in combined form, some of them will be presented with a division into parts A and B because of the additional confidence added by the repetition

Basic Perceptual Data

The main finding from Experiment 1 concerning the relationship between hours of food deprivation and perceptual recognition score is diagrammed in Figure 1 This figure shows the curves of recognition for parts A and B of the experiment, and the total combined curve The lower the score, the lower the relative recognition threshold for food pictures You will observe that food-recognition thresholds steadily decrease until three- and four-hour deprivation (just before and during ordinary meal-time for these subjects), but take a sharp rise at five and six hours.[1]

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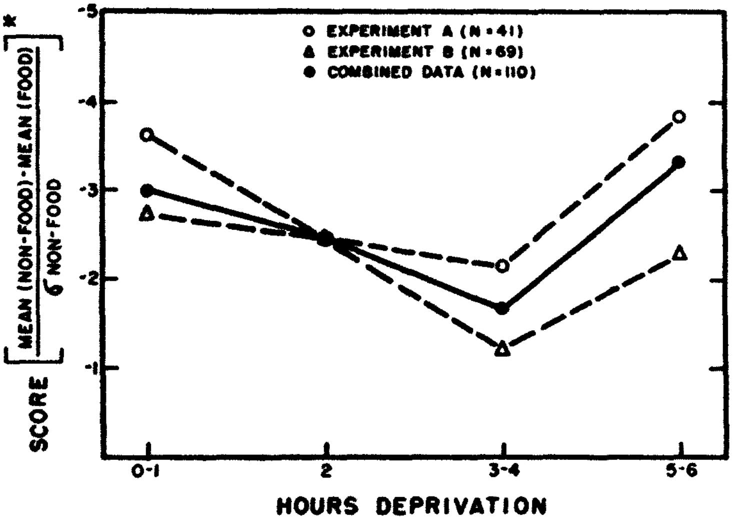
[1] It should be pointed out that the method of scoring recognition thresholds is somewhat atypical, although it has been used by McClelland and Liberman (7) for similar kinds of data It is possible that merely a systematic variation in the sigma



MEANS FOR EACH EXPERIMENT		0-1	2	3-4	5-6
	A	-3.64	-2.47	-2.16	-3.86
	B	-2.74	-2.48	-1.22	-2.28
	COM.	-3.00	-2.48	-1.68	-3.34
	N'S	42	14	34	20

* LOW SCORE MEANS EARLIER RECOGNITION OF FOOD SLIDES

Fig. 1. Relationship between hours food deprivation and perceptual score for experiment 1.

Because of heterogeneity of variance, the scores were transformed into logs in order to perform an analysis of variance on the grouped data. The results of this analysis may be seen in Table I The F test for these means indicates a significance between the 01 and .05 levels of confidence. The nongrouped data follow an essentially similar pattern The picture is quite comparable, although less marked, if subjective hunger ratings are substituted for the hours of

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of the nonfood distribution could produce a pattern of scores such as is reported in Figure 1 To make sure we were dealing with a systematic change in recognition thresholds for the food pictures and not just a change in variability the data have been examined without reference to difference scores, and without using the sigma of the nonfood pictures in obtaining recognition scores For the four deprivation periods, respectively, the mean number of trials needed to perceive correctly the nonfood pictures were 9 59, 8.78, 10 01, and 9 82. The corresponding means for the food pictures were · 16 95, 15.34, 14 88, and 16 60 If the differences between means alone are considered, the figures run as follows 7 36, 6 56, 4 87, and 6 78 This means that the curves for the food pictures alone, and for the differences alone (without consideration of the intra-subject variability in perceiving the nonfood pictures), show the same characteristics as the curve we have presented in Figure 1 Thresholds for food items are high at zero to one-hour deprivation, progressively drop to a low at three and four hours, and rise sharply again at five and six hours No such pattern is found in the means of the nonfood pictures The curve is therefore not a statistical artifact of the particular score used deprivation As hours of deprivation increase, subjective hunger ratings also increase systematically, although the product moment correlation is only 55 For the various groupings of hours of deprivation, the subjective rating goes from 1 89, 2 36, 3 00, to 3 30, respectively While the differential recognition threshold for food pictures is a function of hunger, the recognition of nonfood slides alone does not show any such pattern, indicating that over-all perceptual alertness does not vary with hunger

TABLE I

SIGNIFICANCE OF DIFFERENCE OF PERCEPTUAL SCORE MEANS (IN LOG UNITS) UNDER THE FOUR CONDITIONS OF FOOD DEPRIVATION

Source of variance	df	Sums of squares	F
Between groups	3	16625	3 36*
Within groups	106	1 74602	
Total	109	1 91227	

*For significance at 05 level, F must be 2 70, at 01 level, F must be 3 98

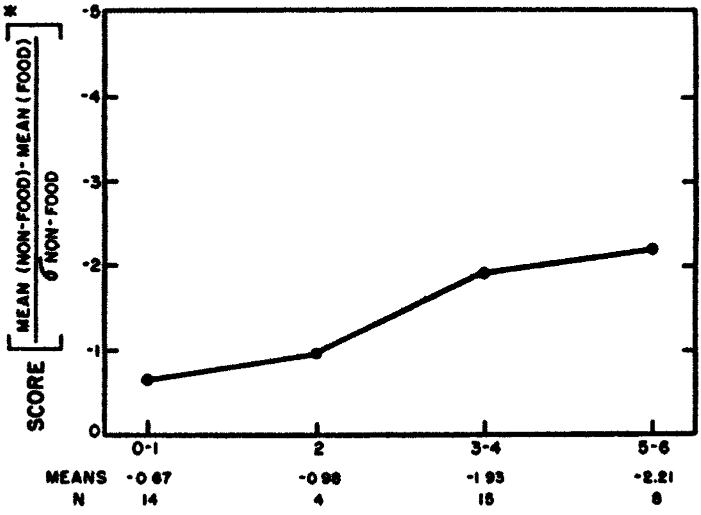
Prerecognition Guesses and Word-Association

In an effort to test the notion that the principle of response availability would account for the relationship between hunger and perceptual recognition, an analysis was made of the frequency of food-related prerecognition guesses as a function of hunger and as a function of recognition score Various measures of prerecognition guesses were used, such as the per cent of the total number of responses which pertained to food or food implements, the per cent of such responses given to only the food slides, and the raw number of food responses In one analysis they were also arranged so that any one response was only credited once, even though the same response may have been given a number of times before it was given up for some other hypothesis

In all of the above calculations the net result was entirely negative There was simply no relationship between any measure of the frequency of prerecognition food guesses and perceptual recognition score, hours of deprivation, or subjective hunger. In other words, hungry subjects made no more incorrect food guesses during the experiment than did nonhungry subjects. Nor did those subjects with low recognition thresholds for food items show a greater frequency of food prerecognition guesses The actual product moment correlation between per cent of food responses and perceptual score was + 08, insignificant in spite of sample of 110 cases

The word-association data, Sanford's finding notwithstanding, were also completely negative There was no tendency for hungry or food-deprived subjects to give more food associations than non-hungry subjects This finding is in line with the negative data obtained by Brozek, *et al*, and is consistent with the prerecognition data

The results of Experiment 2 are comparable in every respect to those of Experiment 1 except with regard to the relationship between hunger and the perceptual recognition score In this case no relationship was found when the subject was tested in a multiple-choice type of situation, in other words, when his freedom of choice is severely limited The essential results with respect to perceptual score and hours of deprivation are presented in Figure 2 The means follow an irrelevant pattern, and do not approach statistical significance If any regularity could be ascribed to the relationship in Experiment 2, perceptual sensitivity to food is highest first after eating and decreases as deprivation lengthens The prerecognition data are likewise negative



* LOW SCORE MEANS EARLIER RECOGNITION OF FOOD SLIDES

FIG. 2 Relationship between hours food deprivation and perceptual score for experiment 2

Qualitative Observations

A number of observations that were made of the subjects' behavior and approach to the perceptual task throw some light on the theoretical perceptual issues and are consequently worth reporting At the earliest tachistoscopic exposures, the subjects' behavior and verbal reports indicated quite clearly that they were guessing without any verbalizable cues about the nature of the stimulus. They often reported that they saw nothing, not even a sign (which is first seen as the illumination increases as a flash) of light. As the variac settings increased, producing more illumination, the subjects' behavior appeared to become largely stimulus-oriented That is, they began making guesses which had a close correspondence with the cues which they were deriving from the stimulus pictures There was often a striking uniformity among subjects in the kinds of guesses they gave to specific stimuli. For example, the picture of an ear of corn had a knife in it which was shown in the position of slicing a few kernels off the ear Because of the particular conformation that the ear of corn, the knife, and the kernels gave the picture at low illuminations, subjects would often perceive this picture as someone rowing a boat. Although this concept is far from accurate in terms of how the picture was finally identified, it was a close approximation to the pattern perceived on the slide at one-fifth of a second and under low illumination. The subjects modified their guesses when new cues made a previous hypothesis untenable, or when new information suggested a better alternative. Subjects differed widely in terms of the tendency to stick to old hypotheses or to originate new ones

Among the most striking things that were observed about the behavior in this situation was the degree of confidence and attitude that the subjects displayed when they made a correct or incorrect guess. If, in many of the pilot subjects, the experimenter asked the subject how confident he was in his guess, the response was usually to the effect that, "Well, I'm not at all certain, but it's the best guess I can make right now It seems most like a ——— " However, when the subject arrived at the correct perception, he nearly always expressed certainty, and displayed the attitude that there was no further need to look Often the subject would suddenly become very uncertain about an old guess, repeat it anyway, saying that he knew it wasn't right, but would observe that he couldn't give a better guess. Then, on one or two successive presentations, he might exclaim, "Oh, of course, a stack of pancakes." There was a marked qualitative difference between the subjects' hypothetical guessing behavior when the stimulus was still relatively unstructured for them, and the judgments made when correctly identifying the stimulus cues There were virtually no exceptions that could be noted in this observation

DISCUSSION

The primary finding of the two experiments which have been reported here is that under the free choice situation, even when the stimulus materials are photographs of real objects which could be uniformly identified after sufficient time, the subject's state of hunger was significantly related to his perceptual accuracy for the hunger-related material. This study is the only reported experiment using hunger as the need variable which has shown that *perceptual accuracy* varies with the need. What is more, the process seems to operate without the kind of "food set" Levine, *et al.*, believed was important On the other hand, when response freedom is limited by a multiple-choice situation, a procedure calculated to produce negative results, no such relationship is found.

This latter finding is somewhat dangerous to interpret because the variability of the scores under the multiple-choice situation was considerably smaller than in the free-response situation. This means that, statistically, it was more difficult to produce any relationship However, what tendency there was for the scores to vary was unrelated to the cyclical hunger pattern and the relationship found in Experiment 1 The present author is inclined to interpret this nonsignificant finding as evidence that need in perception relationships depends upon a wide range of response opportunities Subjects in this second experiment were, perhaps, able very early in the series to pick out the best hypotheses from the list and eliminate many responses which would ordinarily be tried It is possible that the dummy items in the list did not offer what the subjects considered reasonable alternatives and consequently they rejected them A better test of this issue might have been to use items which could have been confused with the actual stimuli The thresholds in this second experiment were lower than in the first There was simply no opportunity for the motivational processes in contrast to the stimulus influences to operate in selecting which responses would be given, and therefore to produce differential accuracy as a consequence of the state of hunger This finding might well be related to the clinical variations of tests like the Rorschach which employ multiple-choice procedures

Equally impressive was the finding that the subjects' prerecognition guesses in no way determined the outcome of the experiment This finding is in keeping with a previous experiment dealing with the auditory perceptual recognition of emotional sentences (4) This is in contrast to the concepts suggesting that perceptual selectivity is largely, if not entirely, a function of the availability of verbal responses The subjects with scores favoring food pictures gave no evidence, either by prerecognition hypotheses or word associations, of "having hunger on their minds," or having greater response availability for food concepts.

It is also interesting to note, in regard to this latter issue, that if the names of the various objects in the experiment are identified in terms of Thorndike-Lorge word counts, the food items have a far larger (nearly double) frequency of occurrence in the English language In spite of this, the nonfood items were uniformly easier to perceive Of course, perceptual recognition of pictures may depend more upon perceptual frequency than upon response frequency. That is, one important thing to examine, were the data available, might be the frequency of these food and nonfood images in visual form rather than words identifying them Since there are no data on this question, it remains open But it is interesting to speculate on the fact that perceptual recognition in this experiment was independent of any measurable verbal factors

One more observation must be discussed It concerns the shape of the curve indicating the relationship between time elapsed since eating and perceptual accuracy for food items In the first experiment which was reported here, differential accuracy for food pictures increases (score decreases) from zero hours of deprivation to 3 and 4 hours, but then takes a sharp rise at 5 and 6 hours As we have seen, previous investigators have, on occasion, obtained comparable findings The present results confirm the empirical finding that perceptual sensitivity increases, then decreases as time from the last meal lengthens, at least up to 6 hours Since the sensitivity is greatest in the present data at about 3 and 4 hours' deprivation, then markedly decreases, the present author is inclined to lean toward Sanford's interpretation that the perceptual curve follows the cyclical food habit. What is needed are data that go beyond those of the present experiment in point of time from the last meal. This could not be done effectively in the college situation without instructing the subjects to starve themselves, a procedure which was avoided here. This kind of pattern is consistent with the frequent reports and subjective experiences of many people who say they are very hungry at the time when they are used to eating, but whose hunger seems to reduce if the mealtime has been passed.

SUMMARY

The half-dozen experiments dealing with the relationship between hunger and perception and association have been discussed. The conclusion was drawn that none of these experiments offers an adequate criterion of perception in their measurements because, in each case, perception is considered with virtually no reference to an unambiguous stimulus, or with any consideration of perceptual accuracy. It was pointed out that variation in the stimulus conditions of the need in perception experiments is needed to understand the mechanism of these relationships.

Two experiments were described in which hunger was varied in four intervals from zero to 1, 2, 3, to 4, and 5 to 6 hours of food deprivation. In the first experiment, employing 110 subjects, five photographs of common food objects and five of nonfood objects were presented tachistoscopically at one-fifth of a second, illumination being varied in an ascending method of limits from 22 volts to 59 volts. Differential thresholds of recognition for the food *vs* the nonfood items varied significantly with degree of food deprivation and subjective hunger. Sensitivity to food items was poorest right after eating, systematically increased to 3 and 4 hours after eating, and dropped sharply at 5 and 6 hours without food. No relationship was found between hunger and prerecognition hypotheses related to food, nor with word-association responses.

In Experiment 2, utilizing 51 subjects, the procedure was varied so that subjects made their guesses from a list of 16 names of objects, 10 of which were used in the tachistoscopic presentation. Half of the list contained food items, and half contained nonfood items. In this multiple-choice form of the experiment no relationship was found between hunger and perceptual recognition.

It was concluded that even when the stimulus is precisely defined and unambiguous under unlimited exposure, tachistoscopic recognition thresholds are a function of the hunger need This need appears to operate in terms of the cycle of eating, resulting in decreased thresholds when the subject normally expects to eat. Moreover, the relationship does not occur when the response variation of the subject is limited by a multiple-choice situation. None of the verbal behavior of the subjects other than that defined by perceptual accuracy was related to recognition thresholds The response-availability concept does not seem to apply to these data Further experiments in which stimulus and response conditions are varied, and in which positive and negative results may be studied, are recommended

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